

PATENT APPLICATION

Docket No. 05369/00007

COATED MONOFILAMENT TAPE
BOBBINS AND METHODS FOR WINDING

CROSS-REFERENCE TO RELATED APPLCIATIONS

This application claims priority from copending Provisional Patent Application Serial No. 60/263,146, filed 22 January 2001, the disclosure of which is hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

Various monofilament dental tapes, as distinguished from multifilaments tapes, have been commercialized which feature reduced shredding, a primary consumer complaint registered for most multifilament dental flosses. These are described and claimed in U.S. Patents Nos. Re 35,439; 3,800,812; 4,974,615; 5,760,117; 5,433,226; 5,479,952; 5,503,842; 5,755,243; 5,845,652; 5,884,639; 5,918,609; 5,962,572; 5,998,431; 6,003,525; 6,083,208; 6,148,830; 6,161,555; and 6,027,592, the disclosures of which are hereby incorporated herein by reference. These dental tapes generally have serious shortcomings in gentleness, in delivering coatings during flossing and in being handled easily and conveniently during flossing

Polytetrafluoroethylene (PTFE) based interproximal devices are described in: U.S. Patent Nos. 5,209,251; 5,033,488; 5,518,012; 5,911,228; 5,220,932; 4,776,358; 5,718,251; 5,848,600; 5,787,758; and 5,765,576, which are hereby incorporated herein by reference. To date, no commercial versions of these tapes have been coated effectively and cannot be used to deliver active ingredients, interproximally and subgingivally during flossing. Handling during flossing, i.e., wrapping the tape around fingers in preparation for flossing, is difficult. Most fail to provide a gentle tape edge. Many tapes are plagued with serious dimensional inconsistency problems, as well.

See also co-pending Patent Applications Serial Nos. 60/227,196; 60/227,239; 60/227,240; 60/227,246; 60/227,244; 60/227,255; and 60/227,433; all of which are hereby incorporated by reference.

Coated monofilament dental tapes including: elastomeric, polytetrafluoroethylene (PTFE), bicomponent and other polymeric tapes coated with ingredients at relatively high levels (between about 20% and 120% by weight of the tape) and increasing by between about 50% and 150% the thickness of the tape after coating are described in the various referenced co-pending applications cited herein. Generally, these coatings are applied to both sides of the monofilament tape. These coated monofilament dental tapes feature an enhanced flossing performance attributed primarily to the various saliva soluble coatings applied to the various monofilament dental tapes. Total delivery of a wide range of active ingredients contained in the coatings into the oral cavity during flossing is a key performance feature of these saliva soluble coated monofilament tapes.

Traditionally, most commercial dental tapes are dispensed in about 18-inch increments from a dispenser package that contains from between about 8 yds. and about 200 yds. of tape wound onto a bobbin means. For promotion purposes, samples of dental tapes are generally distributed in single dose packages containing one or two pieces of tape of about 18 inches each.

Heretofore, uncoated or lightly waxed dental tape dispenser packages have been manufactured using traditional "yarn" bobbin winding means. That is, high speed bobbin winding machines have been adapted from yarn and thread manufacturing operations to wind uncoated or lightly waxed dental tapes suitable for use in traditional dental tape dispensers utilizing methods commonly known in the art for winding waxed or unwaxed multifilament and monofilament dental flosses.

Coated elastomeric and other forms of monofilament dental tapes such as described in the various co-pending applications and issued U.S. Patents cited above have proven to be most difficult to bobbin wind on cores using traditional bobbin winding equipment and procedures. That is, unlike uncoated or lightly waxed tapes, these rather heavily coated monofilament tapes tend to slip off the bobbin during winding, and generally resist buildup to a bobbin of the required yardage. Further, when traditional heat sources are applied to the tape prior to the tape's arrival on the bobbin to "tack" one wind of the tape to previously wound coated tape "winds", the winding tension tends to increase dramatically as the diameter of the wound bobbin increases. This increased tension on the wound bobbin, as it builds, coupled with the near melt heating conditions imposed on the coated monofilament tape coating up-stream from the bobbin core tends to deform the bobbins further. Subsequent exposure of bobbins to high temperature and/or high relative humidity tends to displace the coating and/or deform the bobbin.

Typical bobbin deformations resulting from this increased winding tension with improper conditioning and location of the "tacking" energy input and/or from exposure to high temperature and high humidity includes bobbins which can be described as "out-of-round", "squashed bobbins", "bulging bobbins", "bobbins with displaced coatings squeezed out of the bobbins", etc. Obviously, such misshapen, deformed and coating displaced bobbins do not dispense effectively in the various commercial tape dispensers available, most of which call for commercial bobbins within certain fairly close dimensional

specifications including diameter, width, straight sides, etc. The net is, elastomeric monofilament dental tapes, monofilament PTFE dental tapes, bicomponent tapes and other monofilament polymeric monofilament dental tapes with coatings from between about 20% and about 120% by weight of the monofilament tape, when commercially bobbin wound using conventional thread, yarn and/or dental floss/tape bobbin winding processes and equipment, can produce deformed bobbins that are out-of-spec for use with most commercial tape dispensers and/or bobbins that deform and/or release that coating when exposed to high temperature and/or high relative humidity.

In addition, these coated monofilament tape bobbins tend to deform when exposed to elevated temperatures and/or high relative humidity.

SUMMARY OF THE INVENTION

This invention relates to bobbin winding coated monofilament dental tapes having a wide range of coating levels, using a coating conditioning means in conjunction with a coated monofilament tape tension controlling means to produce substantially round bobbins with the coated tape secured to the bobbin, such that it is dispensed uniformly free from unwinding, backlash, bobbin deformation, with a tack value from between 0.1 and about 0.5 grams.

One embodiment of the present invention is to provide a method for bobbin winding coated monofilament dental tapes at commercial speeds without bobbin deformation.

Another embodiment of the present invention is to provide a method for bobbin winding coated monofilament dental tapes having a wide range of coating levels at commercial speeds without bobbin deformation.

A further embodiment of the present invention is to provide a means for bobbin winding coated monofilament dental tapes constructed of various

polymeric materials, wherein these coated tapes, once bobbin wound, can be dispensed consistently from commercial tape dispensers when exposed to elevated temperatures and high relative humidity.

Yet another embodiment of the present invention is to provide a means for bobbin winding coated elastomeric monofilament dental tapes at commercial speeds free from bobbin deformation where all revolutions (wraps) of the coated elastomeric monofilament tape are secure to the bobbin and such bobbins continue to hold their shape and retain their coatings when exposed to elevated temperature and/or high relative humidity.

Still another embodiment of the present invention is to provide a means for bobbin winding coated monofilament PTFE dental tapes with coatings of between 20% and 120% by weight of the PTFE at commercial speeds free from bobbin deformation and where all revolutions (wraps) of the coated monofilament PTFE tape are held secure to the bobbin and such bobbins continue to hold their shape and retain their coatings when exposed to elevated temperature and/or high relative humidity.

Another embodiment of the present invention is to provide a means for bobbin winding coated bicomponent dental tapes with coatings between 20% and 120% by weight of the bicomponent tape at commercial speeds free from bobbin deformation and where all revolutions (wraps) of the coated bicomponent tape are held secure to the bobbin and such bobbins continue to hold their shape and retain their coatings when exposed to elevated temperature and/or high relative humidity.

Another embodiment of the present invention is to provide a means for bobbin winding coated monofilament dental tapes of polymeric construction with coatings of between 20% and 120% by weight of the polymeric tape at commercial speeds free from bobbin deformation and where all revolutions (wraps) of the coated monofilament tape are held secure to the bobbin and such

bobbins continue to hold their shape and retain their coatings when exposed to elevated temperature and/or high relative humidity.

Yet another embodiment of the present invention is to provide a uniformly wound bobbin of coated monofilament tape that is free from: (a) deformation, (b) premature release of revolutions of the wound tape, and (c) excessive winding tension wherein, upon unwinding, the coated tape releases from the bobbin evenly without disrupting said coating with minimal drag, and substantially free from backlashes and where the coated monofilament tape retains its shape and coating when exposed to elevated temperatures and high relative humidity.

Still another embodiment of the present invention is to provide wound bobbins of coated monofilament tape where some of the coating is conditioned such that said coating adheres to the surface of the previous winds of bobbin wound coated monofilament tape and provides a tack value up to about 0.5 grams.

Another embodiment of the present invention is to provide bobbin wound coated monofilament tape that unwinds evenly free from backlashes with a tack value between about 0.1 and about 0.5 grams.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1, comprised of Figs. 1A, 1B and 1C, are schematic drawings of the bobbin winding process and apparatus of the present invention.

Fig. 2 is a schematic drawing of a bobbin of the coated monofilament tape as it is being wound onto the bobbin.

Fig. 3 is a schematic drawing illustrating the coated tape as it is dispensed from a dispenser showing the coating on both sides of the tape.

Figs. 4 through 10 are bar charts detailing Tack Values for bobbins of various commercial interproximal devices and for bobbins of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Specifically, the present invention relates to bobbins of coated monofilament tape and to an improved means for bobbin winding a broad range of coated monofilament tapes, including coated elastomeric and PTFE tapes, as well as coated bicomponent and other monofilament polymeric dental tapes, wherein said coated monofilament tape is subjected to conditioning means, whereby the coating on said monofilament tape is conditioned to adhere to previous winds on the bobbin and the tension on this conditioned coated monofilament tape is controlled during winding to avoid bobbin deformation during bobbin winding and/or coating displacement and to provide bobbins free from deformation and coating displacement when exposed to elevated temperatures and/or elevated relative humidity.

The coating conditioning means is preferably a physical energy means such as heating, but can be a chemical means, whereby the coating is "tackified" chemically. The conditioning means and winding tension provides tack values for the bobbins of the present invention from between about 0.2 and 0.4 grams.

In a preferred embodiment, the bobbin winding invention includes coating conditioning whereby:

a "temperature conditioning" means is provided prior to wrapping on a bobbin, in combination with:

variable, controlled speed bobbin winding means, thereby minimizing the tension applied to the bobbin as the temperature conditioned coated tape is wound onto the bobbin.

Under some winding conditions, it may be desirable to direct additional energy to the appropriate area of the bobbin utilizing various sources of controllable, "directable energy" such as: hot air, radiant heat, lasers, radio frequency and the like to supplement the coating conditioning.

The present invention provides bobbins of coated monofilament tape having various levels of coating wherein:

the coated monofilament tape remains intact on the bobbin with a minimum of tension,

the bobbin remains substantially dimensionally uniform with substantially no coating displacement, and

the coated monofilament tape is consistently releasable from the bobbin during dispensing with a minimum of drag having a tack value between about 0.1 and about 0.5 grams, and where said bobbin is substantially free from winds falling off the bobbin and is substantially free from "back lashing" and/or coating displacement when exposed to elevated temperatures and/or elevated relative humidity.

The preferred coating conditioning means of the present invention comprises one or more of the following (see details in Figs. 1, 1a, 1b, 1c and 2.):

a controlled "temperature conditioning" means over, through or on a ceramic eyelet which the tape traverses prior to being wound onto a bobbin,

a directable source of energy which is targeted onto the bobbin during winding and/or

a controlled temperature ceramic eyelet that contacts the bobbin during winding.

This "heat tacking" coating conditioning embodiment of the present invention is illustrated in more detail in Figs. 1, 1a, 1b, 1c and 2 of the drawings. The coated tape is illustrated in Fig. 3.

The various monofilament tapes described in the U.S. Patents referenced above can be coated with from 20% to 120% by weight of the coatings described in Table 5 below. These coated tapes can be bobbin wound according to the present invention. Particularly preferred coated monofilament tapes suitable for bobbin winding according to the present invention are described in Tables 1 to 4 below:

Table 1

TAPE COMPOSITION

Ex. No.	Thermoplastic Elastomer Type	Manufacturer	Trade name	Grade	Silicone Process Aid (%)	TiO ₂ (%)	Secondary Polymer added Type (%)	Other Add'n Type (%)
2	PEBA polyester amide	Atofina	PEBAX	55/33	3.5	1.8	PP - 4.7	--
3	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7 Adflex - 5	--
4	ditto	ditto	ditto	ditto	3.5	1.8	PP - 9.7	--
5	PEBA polyester amide	Atofina	PEBAX	63/33	0	0	0	--
6	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2	--
7	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7	--
8	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7 Adflex - 5	--
9	ditto	ditto	ditto	ditto	3.5	1.8	PP - 9.7	--
10	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7 Nylon 11 - 5	--
11	TPE polyether ester	DuPont	Hytrel	6359FG	2.3	1.0	0	Ca Stearate 0.1
12	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7	Ca Stearate 0.1
13	TPE-E polyether ester	DSM	Arnitel	PM581	0	0	0	--
14	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2	--
15	ditto	ditto	ditto	ditto	3	0	PBT - 5	--
16	ditto	ditto	ditto	ditto	0	0	PBT - 5	--
17	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2 PBT - 5	--

Table 1 (cont'd)

PROCESSING CONDITIONS			PROPERTIES			DIMENSIONS			UTILITY FACTORS			
Ex. No.	Melt Temp °C	Draw Temp °C	Draw Ratio	Break Strength in Newtons	Elong- ation to Break (%)	Elastic Limit (%)	Decitex	Width (mm)	Thick (mm)	Gentle- ness Percep- tion	Tape Flex Twist Index	Hard- ness Shore D
2	260	130	6.8:1	30	26	0	750	1.30	0.063	6	4	37
3	260	130	6.5:1	27	18	0	760	1.30	0.063	6	4	37
4	260	130	6.8:1	26	19	0	760	1.30	0.063	6	4	37
5	260	135	6:1	30	15	0	805	1.44	0.065	5.5	4	36
6	260	135	6.3:1	32.36	13	0	800	1.41	0.067	5.5	4	36
7	260	135	6.2:1	33.47	17	0	860	1.36	0.066	5.5	4	36
8	260	135	6.2:1	25.94	14	0	810	1.32	0.078	5.5	4	36
9	260	135	6.2:1	29.46	14	0	780	1.34	0.069	5.5	4	36
10	260	135	6.2:1	30.63	13	0	810	1.30	0.065	5.5	4	36
11	225	130	5:1	20	20	15	1400	1.70	0.070	7	3	33
12	225	140	5.7:1	24	14	10	1230	1.70	0.070	7	3	33
13	235	140	4.3:1	18	13	10	1500	1.63	0.084	7	3	33
14	240	115	4.3:1	19	14	5	1634	1.64	0.085	7	3	33
15	235	140	4.3:1	19	10	3	1580	1.68	0.079	7	3	33
16	235	140	4.3:1	18	12	2	1500	1.70	0.086	7	3	33
17	235	140	4.3:1	21	15	4	1575	1.77	0.083	7	3	33

Table 2
TAPE COMPOSITION

Ex. No.	Thermoplastic Elastomer Type	Manufacturer	Tradename	Grade	Silicone Process Aid (%)	TiO ₂ (%)	Secondary Polymer added Type (%)	Other Add'n Type (%)
18	TPE-E polyether ester	DSM	Arnitel	EM550	0	0	0	--
19	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2	--
20	ditto	ditto	ditto	ditto	0	1.8	PP - 6.2	--
21	ditto	ditto	ditto	ditto	0	0	PBT - 5	--
22	TPE-P polyether ester	OSM	Arnitel	EM630	0	0	0	--
23	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2	--
24	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2 Adflex - 5	--
25	ditto	ditto	ditto	ditto	0	1.8	PP - 6.2	--
26	ditto	ditto	ditto	ditto	0	0	PBT - 5	--
27	TPE-P polyester ester	DSM	Arnitel	UM552	0	0	0	--
28	ditto	ditto	ditto	ditto	0	0	0	Ca Stearate 0.1
29	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2	--
30	ditto	ditto	ditto	ditto	0	0	Adflex - 5	--
31	ditto	ditto	ditto	ditto	0	1.5	PP - 1.2 PBT - 5	Ca Stearate 0.1
32	ditto	ditto	ditto	ditto	0	0	PBT - 5	Ca Stearate 0.1
33	EPDM TPV	Monteil	Adflex	Q100F	0	0	PP - 20	--
34	ditto	ditto	ditto	ditto	3.5	1.8	PP - 24.7	--
35	ditto	ditto	ditto	ditto	7	3	PP - 30	--
36	ditto	ditto	ditto	ditto	7	3	PP - 34.7	--
37	ditto	ditto	ditto	ditto	7	3	PP - 40	--

Table 2 (cont'd)

PROCESSING CONDITIONS		PROPERTIES				DIMENSIONS			UTILITY FACTORS			
Ex. No.	Melt Temp °C	Draw Temp °C	Draw Ratio	Break Strength in Newtons	Elong- ation to Break (%)	Elastic Limit (%)	Decitex	Width (mm)	Thick- ness (mm)	Gentle- ness Percep- tion	Tape Flex- Twist Index	Hard- ness Shore D
18	240	140	4.3:1	23	25	7	1800	1.95	0.096	7	3	33
19	240	115	6:1	27	11	5	1050	1.47	0.071	7	3	33
20	240	140	5.6:1	26	17	5	1216	1.45	0.071	7	3	33
21	240	145	5.9:1	28	145	5	1220	1.55	0.074	7	3	33
22	235	150	4.5:1	18	12	4	1090	1.44	0.067	7	3	33
23	235	150	4.7:1	17	11	4	1130	1.50	0.068	7	3	33
24	235	150	4.6:1	18	10	7	961	1.35	0.065	7	3	33
25	235	150	4.6:1	14	30	10	965	1.24	0.073	7	3	33
26	235	150	4.6:1	20	12	5	1018	1.39	0.069	7	3	33
27	240	150	6.6:1	32	12	8	1300	1.49	0.070	7.5	3.5	31
28	230	150	5.6:1	26	15	8	1090	1.40	0.070	7.5	3.5	31
29	240	150	6.3:1	29	16	8	1150	1.46	0.070	7.5	3.5	31
30	230	140	5.6:1	30	16	10	1233	1.48	0.069	7.5	3.5	31
31	230	145	5.7:1	22	19	10	1108	1.53	0.067	7.5	3.5	31
32	230	245	5.3:1	24	14	8	1143	1.48	0.064	7.5	3.5	31
33	240	130	4.5:1	26	20	0	910	1.60	0.064	5.5	NT	NT
34	240	130	4.5:1	25	24	0	940	1.59	0.064	5.5	NT	NT
35	240	130	4.7:1	28	20	0	870	1.58	0.064	5.5	NT	NT
36	240	130	4.7:1	27	23	0	880	1.58	0.060	5.5	NT	NT
37	240	130	4.7:1	35	18	0	720	1.44	0.063	5	NT	NT

Table 3

TAPE COMPOSITION

Ex. No.	Thermoplastic Elastomer Type	Manufacturer	Tradename	Grade	Silicone Process Aid (%)	TiO ₂ (%)	Secondary Polymer added Type (%)	Other Add'n Type (%)
38	PEBA polyester amide	Atofina	PEBAX	55133	0	1.8	PP - 1.2	--
39	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7 EMA - 3	--
40	ditto	ditto	ditto	ditto	3.5	1.8	PP - 4.7	--
41	PEBA	Atofina	PEBAX	63/33	3.5	1.8	PP - 4.7 EMA - 3	--
42	ditto	ditto	ditto	ditto	0	0	Nylon 11 - 5	PDVF - 3
43	TPE-E polyether ester	DSM	Arnitel	PM581	3	0	0	--
44	TPE-E polyether ester	DSM	Amitel	EM550	3	0	0	--
45	ditto	ditto	ditto	ditto	3	1.8	PP - 1.2 EMA - 3	--
46	TPE-E polyether ester	DSM	Arnitel	UM552	3	1.8	PP - 1.2	--

Table 3 (cont'd)

PROCESSING CONDITIONS		PROPERTIES				DIMENSIONS			UTILITY FACTORS			
Ex. No.	Melt Temp °C	Draw Temp °C	Draw Ratio	Break Strength in Newtons	Elong- ation to Break (%)	Elastic Limit (%)	Decitex	Width (mm)	Thick- ness (mm)	Gentle- ness Percep- tion	Tape Flex- Twist Index	Hard- ness Shore D
38	260	130	6.8:1	28	24	0	775	1.30	0.063	6	4	37
39	260	130	7:1	28	30	3	750	1.30	0.063	8	4	37
40	260	130	6.8:1	29	24	0	800	1.35	0.070	6	4	37
41	260	135	6.5:1	31	20	3	800	1.40	0.065	5.5	4	36
42	260	135	6.2:1	28	14	0	800	1.30	0.065	5.5	4	36
43	235	140	5:1	22	16	7	1400	1.60	0.079	7	3	33
44	240	140	6:1	25	20	7	800	1.30	0.060	7	3	33
45	240	140	6:1	27	15	5	850	1.35	0.065	7	3	33
46	240	150	6:1	27	17	10	1100	1.47	0.069	7.5	3	33

Table 4

TAPE COMPOSITION

Ex. No.	Thermoplastic Elastomer Type	Manufacturer	Tradename	Grade	Silicone Process Aid (%)	TiO ₂ (%)	Secondary Polymer added Type (%)	Other Add'n Type (%)
47	Styrenics SEBS	Alphagary	Evoprene	G978	0	1.8	PP - 1.2	--
48	ditto	ditto	ditto	ditto	3	1.8	PP - 1.2	--
49	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2 EMA - 3	--
50	ditto	ditto	ditto	ditto	3.5	1.8	PP - 9.7	--
51	ditto	ditto	ditto	ditto	3.5	1.8	PP - 9.7 PS - 5	--
52	TPU 90AEN	Dow	Pelethane	2103-	0	1.8	PP - 1.2	--
53	ditto	ditto	ditto	ditto	3	1.8	PP - 1.2	--
54	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2 EMA - 3	--
55	ditto	ditto	ditto	ditto	3.5	1.8	PP - 9.7	--
56	TPV	DSM	Sarlink	4149D	0	1.8	PP - 1.2	--
57	ditto	ditto	ditto	ditto	3	1.8	PP - 1.2	--
58	ditto	ditto	ditto	ditto	0	1.8	PP - 1.2 EMA - 3	--
59	ditto	ditto	ditto	ditto	3	1.8	PP - 6.2	--

Table 4 (cont'd)

PROCESSING CONDITIONS			PROPERTIES			DIMENSIONS			UTILITY FACTORS			
Ex. No.	Melt Temp °C	Draw Temp °C	Draw Ratio	Break Strength in Newtons	Elong- ation to Break (%)	Elastic Limit (%)	Decitex	Width (mm)	Thick- ness (mm)	Gentle- ness Percep- tion	Tape Flex- Twist Index	Hard- ness Shore D
47	200	100	7:1	19	30	10	1100	1.30	0.060	6	4	37
48	200	100	7:1	20	35	12	1100	1.30	0.060	6	4	37
49	200	100	7.2:1	17	32	12	1100	1.30	0.060	6	4	37
50	200	100	7:1	14	20	7	1100	1.30	0.060	8	4	37
51	200	100	7:1	22	28	8	1100	1.30	0.060	6	4	37
52	230	120	7:1	32	15	5	1200	1.40	0.068	7	3	33
53	230	120	6:1	30	17	6	1200	1.40	0.068	7	3	33
54	230	120	6:1	26	16	6	1200	1.40	0.068	7	3	33
55	230	120	5:1	22	10	2	1300	1.45	0.070	7	3	33
56	220	105	4.5:1	20	20	5	1400	1.45	0.072	6	4	37
57	220	105	5:1	22	35	7	1300	1.40	0.070	6	4	37
58	220	105	4.8:1	19	20	5	1350	1.48	0.075	6	4	37
59	220	105	4.2:1	15	20	5	1450	1.48	0.075	6	4	37

Referring to Fig. 1, Fig. 1a is a general schematic drawing of the bobbin winding process of the present invention. King spools of coated monofilament dental tape, designated 1a through 1d, supply coated tapes, designated 2a through 2d, to tension controlled bobbin winders, designated as 5a through 5d. The take up tension on bobbin winders, 5a through 5d, is controlled by programmable logic controller means, 3, through connecting means, 3a, resulting in controlled tension during winding.

Coated monofilament tapes, 2a through 2d, are passed over or through a coating conditioning means, 4, prior to being wound by bobbin winders, 5a through 5d. During bobbin winding, bobbin winders, 5a through 5d, are exposed to a suitable directed energy source, 6, such as hot air, radiant heat, lasers, radio frequency, contact heat, etc., for completion of the heat tacking process. Bobbins wound under these conditions are dimensionally stable, retain the coatings and have tack values between about 0.1 and about 0.5 grams.

Fig. 1b is a side-profile schematic view of bobbin winding means, 5a, with coated monofilament tape, 2a, engaging both the temperature conditioning and coating conditioning means, 4, and directed energy source, 6.

Fig. 1c illustrates coated monofilament tape, 11, passing through heated coating conditioning means, 12, prior to winding onto bobbin, 13.

Fig. 2 illustrates in more detail the winding of coated monofilament tape, 20, as it passes through coating conditioning means, 21, creating a conditioned (pool) of coating suitable for tacking purposes, 22, on the bobbin, 23.

Fig. 3 illustrates monofilament tape, 30, with saliva soluble coatings, 31 and 32, having tack values between about 0.1 and about 0.5 grams.

It is understood, that for the purposes of the present invention, coating conditioning means such as heat tacking can be achieved by (1) using any one of a number of temperature conditioning devices such as a heating bar, a tube or box or low intensity warmed air zone such as produced by a heat lamp at fixed distance, all equipped to maintain a constant controllable temperature and, in the course of passage, pre-heat the monofilament tape and its coating to an optimum temperature, prior to (2) winding in combination with a directable source of energy to the bobbin itself during winding, as illustrated in Figs. 1a and 1b.

Alternatively, a single, coating conditioning means can be used. For example, hot air heat tacking means, 6, as shown in Figs. 1a and 1b, can be used during winding without temperature conditioning means, 4; provided that the underside of the tape, 2a through 2d, is properly heated and made "tacky" but not molten during winding by means, 6. Ideally, this is achieved by means of a heated ceramic eyelet as discussed below and shown in Fig. 1c and Fig. 2.

When coating conditioning means, 4, is used, it is maintained at a temperature such that in the "contact time" provided by the controlled line speed of the bobbin winding mechanism, it warms the coating and the tape to just below the softening temperature of the coating. In one embodiment, a short pass heating "bar" or other surface, at a surface temperature of between about 55°C and 90°C conducts sufficient energy to the tape coating without reaching the melt-temperature of the coating. Practically speaking, contact between the coated monofilament tape and coating conditioning means, 4, is at best, a "kiss". That is, the monofilament tape is traveling at between about 350 and 500 feet/second, and at these speeds, is barely touching the contact surface of coating conditioning means, 4, as shown in Fig. 1b. The net effect is that the coated tape is conditioned and made barely tacky by engaging coating conditioning means, 4, so that coated monofilament tapes, 2a through 2d, can be completely heat tacked during the winding process by the directed energy

source, 6, just preceding the subsequent wraps of the tape on the bobbin under controlled or minimum tension.

The completion of the heat tacking step of applying directed energy, such as hot air to the bobbin during winding is designed to preferably heat the underside of the coated tape, thereby assuring that the final wraps of coated tape on the bobbin are secure, and that the shape of the bobbin is maintained without unwrapping of the tape strands, and/or of strands falling over the side of the bobbin. Such a hot air tacking source generally ranges in temperature from between about 50° and 90°C, while other energy forms are adjusted to momentarily raise the surface temperature of the "just about to be over-wrapped" segment of coated monofilament tape to a similar temperature.

To maintain suitable and essentially constant tension on the temperature conditioned coated tape and bobbin during winding, while avoiding bobbin deformation; the bobbin winding speed is constantly being varied as detailed in Tables 7 through 12 below. That is, at the outset, as the heated coated tape is introduced onto the bobbin core, the core is rotated at relatively higher rpm. This winding speed is then generally continuously reduced as the core is wound with numerous wraps of coated tape, eventually totaling from about 8 up to about 200 yds wound on the bobbin. That is, the winding speed continues to decelerate as the wraps on the bobbin increase and as the bobbin of coated monofilament tape increases in diameter. The directed hot air source envelopes and/or touches the bobbin during the entire procedure, such that the last piece of the coated monofilament tape comprising the last yard is tacked securely to the previous wrap on the bobbin.

A preferred means of achieving this substantially constant tension during winding is to use the Cezoma® bobbin winding machine model number CE 1487-8.0/10.2-91 fitted with a process control computer. The bobbin rotation at the beginning of the cycle (starting speed) is preferably in the range from between about 500 to 350 rpm spindle speed. To maintain suitable

tension on the coated monofilament tape, this starting speed is then gradually reduced during the winding cycle by the process control computer by setting the rate of speed reduction such as to be gradually reduced throughout the wind cycle. It will be obvious to one skilled in the art that the desired shape of a speed reduction curve for a specific coated monofilament tape will be a function of the final thickness of the coating on the tape, as that determines the diameter of the bobbin being formed. See details in Tables 7 through 12 below, which describe additional examples of coated monofilament tape bobbins of the invention wound at various tensions.

Example 1:

An elastomeric monofilament tape 0.002 inches in thickness was coated with a saliva soluble coating as described in Example 77 in Table 5. The loading mechanism was adjusted to produce a coating load of approximately 53 mg/yd. This weight of coating ingredients produced a coating on both sides that was normally 0.001 inches thick (for an overall finished thickness of about 0.004 inches). When using a Cezoma® model number CE 1487 with code 36 set at 225 and Code 37 set at 965, an acceptable bobbin was formed. See also Table 6 below.

The Cezoma® was fitted with a temperature controlled heating bar having a shape such that approximately one inch of the surface touched the tape which passed by under light tension or pressure against the surface. For this example the temperature of the heating bar version of the Coating Conditioning means was maintained at 80°C plus/minus 3°C.

The Cezoma® was also fitted with a hot air manifold which directed its energy to the underside of the bobbin such that the surface of the tape next to be overlaid in the wrapping rotation was exposed momentarily to a stream of air exiting the manifold at approximately 50°C.

Preferably, the ceramic eyelet on the traverse block on the winder is heated, thereby avoiding heating the entire bobbin during winding. By heating the ceramic eye, the coated monofilament tape is heated immediately prior to being laid onto the bobbin. This embodiment allows for producing wound bobbins of greater lengths without deformation attributed to excess heat energy. Details of this heated ceramic eyelet arrangement are illustrated in Fig. 2 of the drawings.

Under these conditions, substantially uniform bobbins containing 8 and 200 yds of product could be produced routinely at commercial speeds with no bobbin deformation. When placed in dispenser packages and stored, these bobbins can be dispensed without difficulty or loss of product integrity.

It is critical to this invention that both the rate of speed (rpm) change and the shape of the curve expressing said speed change be controlled according to the physical parameters of the coating on the tape being wound.

A series of coated elastomeric tapes as described in co-pending Provisional Patent Application Serial No. 60/263,220, and as detailed in Table 5, were bobbin wound using the bobbin winding process of the present invention. The results of heating with single source of heat (or no heat) in a manner common to the industry are also described in Table 5 in the rows labeled "heat needed to wind" and "bobbin tack". However, when the method of heat tacking described herein was used, each formula could produce a nearly perfect bobbin with appropriately selected conditions for the elements of (1) coating conditioning, and (2) controlled tension.

Saliva soluble coatings for monofilament tapes to be bobbin wound according to the present invention are described in Table 5 below. In the Table, the term "Ultramulsion 10-2.5" is defined as an emulsion of polydimethylsiloxane (PDMS) at 2.5 million cs in a nonionic surfactant Poloxamer 407, where the PDMS is at 10% by weight of the total emulsion.

Table 5

EXAMPLE	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
Ingredient																		
Ultramulsion 10-2.5*	57.1	54.8	52.3	50.8	50.8	50.8	58.8	60.8		60.1	55.1	51.1	60.1		61.1	61.1	53.1	57.1
POLOXAMER 407									60.1					60.1				
Emsorb 2726	12.5	7.5	12.5	9	5	3	3	0	3	3	3	3	3	3	4	3	3	3
Stearyl Alcohol	9.2	10.5	8	7	11	13	15	16	15	15	15	15	15	15	10	8	15	15
Insoluble Saccharin	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Propyl gallate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Spicemint Flavor	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5
Vanilla Mint Flavor	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5
tetrasodiumpyrophosphate	8	14	14	10	10	10	10	10	10		10	14	4		6	6	10	6
dicalcium phosphate										10			6	10				
Microcrystalline Wax ML 445				10	10	10	0	0	0	0	5	5		0	7	10	7	7
Triclosan	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3										
Observation																		
Need heat to wind	y		n	y	y	n	y	y	y	y	y	y	y	y	y	y	y	y
Bobbin tack (1=poor, 5=good)	1		5	5	3	4		4	3	2	4	4	3	3	4	3	4	4
Flake resistance																		
Feels sticky (1=no, 5=very)				5	4	4	2	1	2	2	3	3	3	1	4	3	4	4
Load of two samples	29/19	na	na	43/50	28/11	53/39	58/43	33/20	51/40	33	46/53	40/39	38/38	50/37	48	45	38/39	43/39

Similar bobbin winding results are obtained with coated PTFE and bicomponent dental tapes and other similarly coated polymeric tapes.

When either of the bobbin winding means of the present invention are deleted from the bobbin winding process, the resultant bobbins are of lesser quality and generally unsuitable for commercial use.

Another embodiment of the present invention is directed towards "dynamic cores" which are responsive to the compression forces created by extended exposure of the bobbins of coated monofilament tape to high heat and humidity, i.e., temperatures of 40°C and above and relative humidity of 75% or greater.

Extended exposure of bobbins of coated monofilament tapes of the present invention to high temperatures and/or high relative humidity tends to either: (1) cause the molecules in the monofilament tape elastomer to re-orient causing the tape to contract as it becomes more elastomeric while applying increased compression pressure on the core, or (2) cause the saliva soluble coating to absorb more water and thereby increase the coating load while applying increased corresponding compression pressure onto the bobbin core.

Failure to provide relief from these compression forces results in either the coating oozing from between the winds of the bobbin onto the sides of the bobbin and/or the bobbin winds moving laterally causing a misshapen bobbin. In both instances, the bobbin generally does not dispense properly.

The dynamic cores of the present invention are responsive to these compression forces and tend to maintain the bobbin free from coating oozing and free from wind distortion when exposed to high temperature and high relative humidity conditions, thereby allowing the bobbin to dispense properly.

The dynamic cores of the present invention are manufactured from various substances including plastics and spring steel and are characterized by a variable diameter such that the core changes in diameter dimension in response to varying compression forces while maintaining a generally round dimension enabling it to rotate on the dispenser hub.

The compression forces on the core of coated monofilament tape loaded at 40 mg/m bobbin wound to 25 meters when stored at 40°C and 75% humidity decreased the core diameter substantially after 90 days. After 90 days, when exposed to these conditions, the bobbin provided with a dynamic core remained substantially free from wind distortion and free from premature coating release and dispensed properly.

The corresponding bobbin wound at 50 meters and stored under comparable conditions produced a bobbin core with a substantially higher reduction in diameter after 90 days.

The compression tension on the core of the bobbins of the present invention are the product of the tension imposed on the coated monofilament tape as it winds onto the bobbin and as the bobbin is expanded from a single wind on its core to the multiple winds required to place 8, 10, 25, 50, 100 or 200 meters of coated monofilament tape onto the bobbin. As these winds of coated monofilament tape are built up on the bobbin the tension on latter winds of the coated monofilament tape is progressively reduced by reducing the revolutions per minute (rpm) the expanding bobbin core is being wound.

Thus, the tension placed on the 25th yard of coated monofilament tape wound onto a 25 yd bobbin is substantially less than the tension placed on the first yard of the tape wound onto the bobbin core. This reduction in tension on the tape as the bobbin is being wound is particularly critical to those coated monofilament tapes which may be placed under high temperature and/or high humidity conditions later on.

Set out below in Tables 7 through 12 are the results of bobbin winding a series of monofilament dental tapes of the invention coated with saliva soluble coatings such as described in Table 5 at between about 30 mg/yd and about 60 mg/yd. These bobbins were wound using a Cezoma®, Model No. CE 1487 with Code 36 set at: 25, 75, 125, 175, 225 and 255, respectively, and Code 37 having start and finish RPM as reported. The Tack Values for some of these bobbins are detailed in Table 14 below.

Table 7

Code 36 @ 25

Code 37	RPM Start	RPM Finish
999	411	382
985	411	382
965	411	382
955	411	382
935	411	382
905	411	382
800	411	382
700	411	382
600	411	382
500	411	389
400	411	389
300	411	389
200	411	389
100	413	395
0	488	488

Table 8

Code 36 @ 75

Code 37	RPM Start	RPM Finish
999	494	382
985	494	382
965	494	382
955	494	384
935	494	419
905	494	444
800	494	470
700	494	455
600	494	470
500	490	472
400	499	485
300	498	481
200	499	468
100	499	485
0	494	487

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Table 9

Code 36 @ 125

Code 37	RPM Start	RPM Finish
999	457	378
985	554	384
965	556	382
955	565	382
935	577	420
905	567	472
800	577	531
700	575	547
600	573	549
500	573	553
400	573	556
300	573	556
200	573	558
100	573	569
0	573	572

Table 10
Code 36 @ 175

Code 37	RPM Start	RPM Finish
999	514	384
985	635	378
965	641	542
955	644	453
935	644	520
905	646	556
800	646	608
700	650	624
600	650	632
500	650	633
400	650	632
300	650	637
200	650	630
100	650	641
0	650	648

Table 11
Code 36 @ 225

Code 37	RPM Start	RPM Finish
999	600	380
985	709	481
965	716	496
955	716	554
935	720	575
905	722	632
800	720	689
700	725	703
600	723	707
500	727	714
400	734	720
300	727	714
200	725	716
100	725	718
0	727	727

Code 36 @ 255

Code 37	RPM Start	RPM Finish
999	655	389
985	755	551
965	747	553
955	760	611
935	766	648
905	766	701
800	769	736
700	771	718
600	771	756
500	773	758
400	773	760
300	771	762
200	773	762
100	773	767
0	771	767

For the purposes of the present invention, Tack Values for the bobbins of coated monofilament dental tape are determined by measuring the amount of free-hanging tape in grams, suspended from the bobbins, needed to overcome the tack of the wound tape on the bobbins, wherein once this tack value is attained, the bobbin will continue to unwind, being driven by the weight of the tape suspended from the bobbin.

The tack values for commercial products were determined by adding weight to the unwound, suspended product until the tack of the bobbin was overcome and the bobbin would continue to unwind, driven by the suspended product/weight combination.

One of the surprising and distinguishing features of the coated monofilament dental floss bobbins of the present invention are the Bobbin Tack Values for the bobbins of the present invention compared to the Bobbin Tack Values for various commercial dental tapes and flosses.

The Bobbin Tack Values for various commercial interproximal devices are summarized in Fig. 4, a bar chart setting out these relative Bobbin Tack Values.

The Bobbin Tack Values for the various bobbins of the present invention as described in Tables 7 through 12 are summarized in Table 14 and Fig. 5.

Clearly, the Bobbin Tack Values for the bobbins of the present invention are dramatically lower than current commercial products.

Table 13

Floss Bobbin Tack Value in Grams

Glide® Floss	2.2258
Oral-B Satin Tape®	78.0629
Colgate Total® Mint Waxed Floss	3.2872
Eckerd Hi-Tech Floss	2.1775
J&J REACH® Gentle Gum Care Fresh Mint Floss	2.5953
J&J REACH® Whitening Mint Floss	8.2387

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Table 14

Coated Monofilament Tape

Bobbin winder settings are as follows: Code 36 (Winding Speed) = 25, 75, 125, 175, 225, 255; Code 37 (Reduction Speed) = 999, 985, 965, 955, 935, 905; Air Heat Temperature = 76.3°C; Eyelet Temperature = 60.4°C

BOBBIN	TACK VALUE in grams
255-999	0.2768
225-999	0.2233
175-999	0.1906
125-999	0.2505
75-999	0.2984
25-999	0.2302
255-985	0.3516
225-985	0.2130
175-985	0.1985
125-985	0.2365
75-985	0.3015
25-985	0.2278
255-965	0.2759
225-965	0.1632
175-965	0.2367
125-965	0.1977
75-965	0.3230
25-965	0.2414
255-955	0.2411
225-955	0.1570
175-955	0.1591
125-955	0.1819

BOBBIN	TACK VALUE in grams
75-955	0.3320
25-955	0.2404
225-935	0.2290
225-935	0.2279
175-935	0.2298
125-935	0.2243
75-935	0.3146
25-935	0.2778
255-905	0.1826
225-905	0.1770
175-905	0.1617
125-905	0.2856
75-905	0.3251
25-905	0.2689

The present invention has been described in detail, including the preferred embodiments thereof. However, it will be appreciated that those skilled in the art, upon consideration of the present disclosure, may make modifications and/or improvements on this invention and still be within the scope and spirit of this invention as set forth in the following claims.